OPERATION AND MAINTENANCE MANUAL

TRANSORMA

LETTER SORTING MACHINE

PITNEY-BOWES AND WERKSPOOR
Stamford, Connecticut

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PART I

GENERAL DESCRIPTION AND OPERATION

TRANSORMA LETTER SORTING MACHINE

DESCRIPTION.

The Transorma Letter Sorting Machine is designed to sort lettermail into as many as 300 different catagories, and may be used for performing sorting operations, on incoming or outgoing mail or both at the same time as required. When different types of sorting operations are performed in succession, care should be taken to clear the machine of all mail between sorts.

Letters exceeding a length of 10 inches, a width of 6-1/2 inches and more than 1/4 inch thick should not be sorted in the machine. In addition, no attempt should be made to sort letters containing metal objects, coins, etc., or letters that are damaged, folded, or improperly sealed.

The Transorma Sorting Machine consists of an upper and lower section separated by a platform which extends completely around the machine. In the upper section of the machine, above the platform, are five feed conveyors and five operator positions with a sorting keyboard and seat for each. A conveyor belt is provided for transporting mail from the lower floor level to the upper section of the machine.

Inside the central portion of the machine are the driving and sorting mechanisms and the letter carrier train. The letter carrier train is an endless conveyor which runs the full length of the machine and consists of a series of individual letter carriers for conveying letters from the sorting keyboards to the numbered letter receptacles.

These receptacles, for stacking the sorted letters, are located underneath the platform at floor level. They are arranged in verticle rows of five receptacles each, 30 rows to each side of the machine. At the back of each receptacle is a mail chute leading from the receptacle to the letter carrier train through which letters travel from the train to the receptacle.

Each receptacle is provided with signal lights to indicate when it is full and also to show when it has become overfilled, or its chute clogged. Receptacles are consecutively numbered from 0-74, 100-174, 200-274, 300-374 and may also carry destination names.

OPERATION.

The machine is started by pushing a main switch button located to the left of the first operating position. A hand wheel is provided for starting the main drive motor and for controlling the speed of the machine over a range of 30 to 53 letters per keyboard, per minute. Each of the sorting keyboards is turned on separately by a button located on the left side of the keyboard and by inserting a marking key in the keyboard lock. The keyboard and its corresponding letter feed will not operate unless this marking key is in position. Each operator is provided with a separate marking key, and its purpose is to mark each letter sorted with a special character. This makes it possible to trace quickly any mis-sorted letters resulting from operator errors or machine malfunctioning.

Mail is supplied to each operator position by an automatic feed conveyor. Letters are loaded into the conveyor in an upright position, faced front, and a push plate moves them toward the operator. As letters are removed from the front of the letter stack in the conveyor, the stack is moved forward so that the first letter is always in the same position. The feed is automatically controlled by a feeler arm at the front of each conveyor.

Letters are removed one by one from the conveyor by a vacuum device and dropped in front of the operator. The operator reads the letter destination and presses the necessary sorting number on the keyboard.

The five keyboards are arranged as follows:

At the right hand side: 9 keys for the "units"
At the center: 9 keys for the "tens"
At the left hand side: 3 keys for the "hundreds"

The keyboard is operated with both hands, the "units" and the "tens" with the right hand, and the "hundreds" with the left hand. Keys should be depressed all at the same time with a single motion.

No zero is provided on the keyboard, since zero is obtained when no keys are pushed. A correction key is provided for canceling an incorrect number. When this key is used, the letter is sorted to the "zero" receptacle. Letters with illegible addresses, etc., should also be sorted to the "zero" receptacle.

After the letter destination has been read, it is pushed to the right by a push-pin which is actuated at regular intervals according to the overall speed of the machine. Thereafter the letter is clamped by an inverting device which turns the letter 90° to a vertical position and drops it behind a transparent shield in the machine where it is automatically marked by the marking key. At this point the letter rests in a vertical position in the insertion mechanism, on a bottom flap just above the letter carrier train. As one of the letter carriers passes directly under this mechanism, the bottom flap opens and the letter is ejected by a set of feed rollers into the letter carrier. At the same time, a counter is actuated by the passing letter.

Each of the letter carriers is fitted with a letter tray for transferring letters from the keyboard to the sorting receptacles. Carriers are linked together one behind another to form the endless train conveyor. This train moves at a rate which corresponds to the rate of insertion of the letters and is set by the speed-control handwheel.

The five keyboards are synchronized to the movement of the carrier train and during the period of time in which five carriers pass underneath a certain keyboard, the drive shaft of this keyboard makes one revolution. Letters sorted by this keyboard will, therefore, be ejected into each fifth carrier in the train. This prevents letters from different keyboards falling into the same carrier and also distributes the sorting operation evenly among the 5 operators.

Each letter carrier has a set of nine indexing fingers which correspond with tumbler cams, actuated by each keyboard. As the letter carrier passes under the tumbler cams, certain carrier fingers are depressed and indexed according to the cam setting. Each letter carrier is individually indexed in this manner for delivering its particular letter to the proper receptacle.

After indexing, the train of carriers moves to a tilting mechanism. This mechanism tilts the letter tray in each carrier to any one of ten pre-determined positions. Tilting of the letter trays is accomplished by first swinging the bottom of the tray to the right as far as it will go, and then back again until a position corresponding to the setting of depressed fingers is reached. A locking device then engages an arm on the carrier, locking the letter tray in the proper tilted position.

The train of carriers then moves down the center of the machine and over the upper ends of the chutes leading to the receptacles. The carrier track over the receptacles is fitted with an ejecting mechanism directly over the chutes leading to each vertical row of receptacles. (One ejecting mechanism is used for every ten receptacles, five on each side of the machine.) Each is fitted with feeler pins, and when the indexing of the carrier fingers corresponds with the setting of these feeler pins, a lever on the carrier is actuated to eject the letter. At the moment the letter is ejected, the bottom of the letter tray will be directly over one of the ten receptacle chutes, depending upon the tilted position of the letter tray. In this manner, each letter reaches its proper receptacle, as sorted by each of the five keyboards.

After the carriers have passed the receptacle chutes, the letter tray in each is tilted to its extreme left or neutral position by means of a redressing mechanism. At this point, too, a special mechanism provides a constant and automatic check to insure that all trays have discharged their letters. This mechanism allows only carriers with open bottoms to pass. A tray with a closed bottom, indicating faulty ejection, trips a safety device which stops the machine and lights a signal lamp.

Just before the carriers again reach the keyboard positions, all trays are brought from the neutral position (extreme left) to a vertical position, ready to receive another letter. At this point, the bottoms of all carriers are closed and locked, and their indexing fingers are returned to the neutral position by a roller. As each carrier leaves this position, it is ready for its next cycle.

In the Transorma Sorting Machine, there are a number of safety devices which insure proper operation. In addition to the device that insures that all trays have ejected letters, there are others which insure proper closing of all letter trays, check whether trays have been put in proper neutral position by the repositioning mechanism, and which insure that trays have been locked in the correct tilt position by the tilting mechanism. Each safety device is connected to a separate signal lamp, and each stops the machine when tripped.

Letters not properly handled by the machine between the keyboard and carrier also stop the machine and light a signal lamp. They can be instantly removed by the operator by lifting the keyboard.

All letter receptacles in the lower section of the machine are identical except for the lowest one in each row. These are designed for a larger mail capacity, and are equipped with spring loaded bottoms which aid both in stacking and removing letters. Several of these lower receptacles utilize a drawer arrangement for easier unloading. These are designed for sorting to large cities or clients.

At the back of each receptacle is a short chute which connects directly with the discharge chute from the carrier train. Each of these short chutes has a hole through it, and the holes of each verticle row of five chutes are aligned. A lamp and lens arrangement inside the machine projects a beam of light through these holes, onto a mirror, and to a frosted glass window over each row of receptacles. When, for any reason, letters remain in the short chutes, the light beam is interrupted and the light does not appear in the frosted glass window. This arrangement makes it possible to see at a glance whether one of the receptacles in a particular row is over filled, or a chute for that row is blocked. The larger drawer-type receptacles are provided with a buzzer signal as well as the lamp.

In addition, receptacles are provided with a celluloid guide plate which not only aids in stacking letters, but in addition, actuates a signal light when the receptacle is filled. When letters enter the receptacle they slide under the guide plate raising it until it actuates a switch. This switch turns on the signal light for that particular row of receptacles, and lights a general signal as well.

Each receptacle is equipped with a spring loaded door to simplify mail removal. Drawer-type receptacles automatically return to their initial position after mail has been removed.

PART II

TECHNICAL DESCRIPTION OF PARTS OF THE TRANSORMA LETTER SORTING MACHINE

A. THE CARRIER TRAIN AND LETTER TRAYS. (Drawing 1004.11.000)

Each carrier in the carrier train consists essentially of a bent strap member, 1266, connected to two plates, 1267/1268, by links, 1290/1292. Individual carriers are linked together to form a train by pins, 1295. Each carrier is kept on the carrier track by a ball bearing roller, 505, attached to the lower end of pin 1295. This roller runs in a guide rail underneath the carriers. The guide rail should be periodically lubricated with heavy oil.

Each carrier is fitted with two wheels, one for the outside and the other for the inside rail of the carrier track. The outer wheel is mounted directly on the strap which forms the carrier body, and the other is mounted at the junction between carriers. The wheels are rubber tired, and tires should be replaced when worn down to a diameter of approximately 3 inches. A tire cone has been supplied to facilitate sliding replacement tires onto the wheel rims. (The cone should be dusted with talcum powder before use). The rubber tires are glued to the surface of the wheels to prevent them from rolling out, and becoming loose. Before sliding on a new tire, the wheel surface has to be cleaned and fresh glue applied to the wheel. To avoid excessive tire wear, the inner wheels of each carrier are designed to turn automatically as curves are approached. These wheels are supported on a double gudgeon, 1297, 1298, and since this part is not symetrical, care should be taken to replace it in the correct position whenever carriers are reassembled.

The carrier indexing fingers, 1270, are mounted in plates, 1267/1268. These are held in proper position by leaf springs, 1271. These springs should be periodically checked and replaced if they allow the fingers to slide up and down too easily. When the indexing fingers move too freely, they cannot be properly indexed and will cause mis-sorting. The fingers should hold a pressure of approximately one lb. without sliding. A testing meter 4425 has been supplied for this purpose.

The carrier letter tray consists of two side walls, 1234, attached to the yokes 1232/1233. This assembly is hinge-mounted on ballbearings to the carrier strap by two bolts 1237 so that it is free to swing to the right or left. Two springs, 1240, hold the tray tilted to its extreme left (neutral position) when unlocked.

A ten-tooth quadrant, 1241, is mounted on the yoke 1232, and a pawl, 1286, engages the teeth on this quadrant so that the tray may be positioned in any one of ten positions. This pawl is fixed to lever 1283 which is in turn mounted on the carrier strap. This lever has a ballbearing, 502, at its upper end. The quadrant mechanism is adjusted by inserting or removing washers 1287 between the pawl and the lever on which it is mounted. When the pawls of all trays are engaged in the same quadrant tooth, rollers 1242 underneath all trays should be in alignment. This adjustment must be accurately made since the rollers 1242 are used to set the tilt angle of the trays and as reference points for the safety devices. The pawl is held against the quadrant by spring 1289. Trigger 1280 is used to lock the pawl away from the quadrant. When this trigger is engaged, the quadrant is free to move and the tray will swing to its neutral position by the action of springs 1240. The contact area of the locking trigger and lever should be periodically lubricated with light oil.

The tray bottom flaps 1261, and leaf springs 1262, are mounted on two shafts

1259/1260. These shafts are hinged to levers 1253/1254 which are held in position by block 1256 and springs 1257/1258. These shafts are sufficiently flexible to bend slightly when thick letters are ejected from the tray.

The mounting hole of block 1256 is slotted to permit adjusting the block up or down. This adjustment is used to control the distance between the leaf springs in the letter tray. Springs should be adjusted so they just touch one another when the bottom of the tray opens. In making this adjustment, be sure that block 1256 remains horizontal. Unless this is observed, the action of connecting rods 1246 and levers 1263 may be reversed and the tray bottom flaps will turn in the wrong direction.

Connecting rods 1246 are linked to a locking bar 1243, to which a ball bearing, 501, is attached at the upper end, and a small eccentric disc 1245 at the lower end. When the bottom flaps of the tray are locked, the locking bar is held in the closed position by the eccentric disc which engages ball bearing 501, mounted on a pair of links 1248/1249. Link 1248 has a small slot which engages an unlocking trigger 1275. When this trigger is depressed, the eccentric disc on the locking bar is disengaged from the ball bearing and the locking bar is pulled away by the tension of springs 1247, and the bottom flaps of the tray open.

The closed position of the bottom flaps is adjusted by turning the eccentric disc, 1245, until the proper angle between tray bottom flaps is reached. An angle gage is supplied for this purpose. When correctly made, this adjustment should allow a clearance of .240 inch between the springs, 1262 in the tray. All pivots of the tray opening mechanism should be periodically lubricated to insure proper operation and rapid ejection of letters from the tray.

Two adjustable limit stops (eccentric rings 1274) are attached to the carrier strap to limit the swing of the letter trays at their extreme positions. The neutral position stop of all carriers should be adjusted so that the alignment rollers, 1242, at the bottom of all trays are in line when the trays are in the neutral position. The other limit stop is adjusted to allow the tray to swing to its extreme position in the opposite direction, but not so far as to permit the trigger to disengage from the slot in link 1248.

To remove trays, springs 1240 should first be disengaged. After unscrewing bolts 1237, trays can be removed downwards out of the carrier.

Trays are installed in the carriers from the bottom by lifting them into position and inserting ball bearing 503, spacer ring 1164 and bolts 1237. Before tightening bolts 1237, be sure that the unlocking trigger 1275 is engaged in the slot in link 1248. Finally, tension springs 1240 should be reinstalled. Before placing the carriage in operation, the position of roller 1242 should be checked for alignment, and washers inserted or removed from the locking pawl as required. In addition, the letter tray tilt stops should be adjusted if necessary.

The neutral and first tilt positions of all trays may be checked by the two angle gages mounted on the frame of the machine. The entire train of carriers should be checked against these gages from time to time to insure that all carriers are in proper alignment.

B. KEYBOARD ASSEMBLY AND FEED CONVEYOR.

The keyboard assembly consists of seven groups:

1. Carrier Finger Indexing Assembly
2. Letter Insertion Assembly

3. Marking Key Assembly
4. Letter Feed Conveyor
5. Automatic Feed
6. Keyboard
7. Letter Feed Vacuum System

1. CARRIER FINGER INDEXING ASSEMBLY (Drawing No. 1027.21.000)

The carrier finger indexing assembly is part of the overall keyboard assembly, and its purpose is to index the carrier fingers according to the sorting number that has been set into the keyboard by the operator. Each keyboard assembly is actuated by a main driving roller, 1364. This roller has five helical grooves in its surface which mesh with the rollers on the inner wheels of the letter carriers. As each letter carrier moves in succession past the keyboard assembly, it engages the roller and provides the driving power for the keyboard assembly. The pitch of the helical grooves in the driving roller is such that the roller makes one revolution for every five carriers in the carrier train.

The shaft of the driving roller also serves as a pivot for raising the keyboard for access to its mechanism. The keyboard assembly is raised by knobs 1386, and is held upright by springs 1380.

Power from the helical drive roller is transferred to shaft 4423 in the keyboard assembly through a chain and sprocket, 1397 and sliding clutch 1399. The transmission ratio is 1:1. The keyboard is engaged by the operator by actuating this clutch. The clutch engaging mechanism consists of knob 1413, on drw. 1027.22.000, shaft 4986, clutch 1412, lever 1405, shaft 4978, and ball-bearing roller 508. When the clutch control knob is moved, it moves clutch coupling 1399 into engagement with the coupling pin 1401. Since there is only one point at which coupling 1399 will engage pin 1401, synchronization of the keyboard with the carrier train is assured.

The carrier finger indexing assembly is actuated by a reciprocating motion of levers 5103, coupling bolt 5105, and roller 5104. Cam 4424 provides the motion through cam follower 514, lever 1419 and shaft 1417 to which levers 5103 are attached. A spring 1410 provides the return motion.

Indexing of carrier fingers is accomplished by 9 tumbler cams 5106 mounted on a common shaft. Each of the tumbler cams can be locked by pawl 5109. When a key on the keyboard is depressed, solenoids 5113-5114 are energized, lifting pawl 5109 out of engagement with the tumbler cam. The reciprocating motion of roller 5104 raises the tumbler cams slightly to aid disengagement. The tumbler pivots down, following the reciprocating motion of roller 5104, under the force of spring 1434 acting through lever 1429 and roller 507. This roller also locks the tumbler in its lower position. In this position, the tumbler cam is aligned with one of the fingers of the carrier, and as the carrier passes beneath, the indexing finger is depressed about 3/8 inch by the tumbler cam. As soon as the carrier has passed, roller 5104 attached to arms 5103 returns the tumbler cam to its neutral position where it can be locked again by pawl 5109 which has been released by the solenoids.

This locking action must be precisely adjusted, and is most easily accomplished by removing the entire frame to which the tumbler cams, pawls and solenoids are fastened. To remove this frame, take out shaft 5104 by unscrewing bolts 5105, disconnect the cable plug, and remove bolts 562. Correct adjustment of pawl 5109 is obtained when it overlaps the notch on the tumbler wheel approximately

1/32 inch. Adjustment is made by turning screws 528 in the adjusting bar 4586 (see Maintenance Instructions, Part III). Screws 529 in pawls 5109 are used to adjust the return action of the pawls when released by the solenoids.

An interlock mechanism is provided on the keyboard to insure that all tumblers will be in the neutral position at the time the keyboard is disengaged. This interlock consists of bolt 1416 which prevents disengagement of the clutch coupling unless roller 5104 and levers 5103 are in the neutral position.

A safety device has been incorporated in the keyboard assembly to insure that all carriers are closed before they are indexed for their next cycle. This device consists of switch 504 actuated by bar 9430 and spring 2159. The roller at top of the locking bar on the carriers actuates this switch in the event the letter tray is not closed. Switch 504 stops the machine and lights a signal lamp.

Electrical connections to the assembly are made at terminal strip 506 under cover 4997. Electric power should be turned off before electrical repairs are attempted.

2. LETTER INSERTION ASSEMBLY (Drawing No. 10027.22.000)

The purpose of the letter insertion assembly is to deliver letters into the letter trays of the carrier train at the proper moment as the carriers pass under each keyboard.

This assembly consists of two sets of rollers which, at the properly synchronized moment, grip the letter and eject it at high speed from the letter slot of the insertion assembly into the letter carrier tray passing underneath. Before being ejected, the letter rests in a slot between the rollers and is supported by a metal flap, 1513, in the bottom of the slot.

At the same instant the letter is gripped by the rollers, the bottom flap is opened by cam 1061 on camshaft 4600, lever 1519, rod 1517, and lever 1120. For correct adjustment of this mechanism, approximately .010 inch should be allowed between cam 1061 and cam follower (ball bearing 503 on lever 1519) when the bottom flap is closed.

Insertion rollers 1483/1484 are turned continuously, by shaft 4600 through a 1:3 ratio gear train and a friction coupling, 1492. The friction coupling prevents possible damage to the drive mechanism in the event the roller is not free to revolve.

The counter rollers, 4420, are not driven. These rollers are mounted in a bracket, 1497, which is suspended by links 1502 from journals 1504/1506. The counter rollers are pulled against the revolving rollers by the action of springs 1512, cam 1474, lever 1509, and rods 1508.

At the beginning of this action, the distance between the two rollers should be approximately 1/2 inch. As cam 1474 rotates, the distance between rollers decreases until a letter is gripped between them. The bottom flap should be open approximately 3/16 inch by the time the distance between the rollers has also become 3/16inch (see drw. 903.374.641). The rollers are mounted in an inclined position, and as a result, the letter is given both a downward and forward motion in the direction of the movement of the carrier train. This insures that the letter will be properly deposited into the tray of the moving carrier.

The insertion roller is rubber faced and is subject to very little wear. The rubber facing rings can become damaged by sharp objects contained in letters, and a cone has been supplied to facilitate their replacement if required.

Failure of the insertion assembly to operate can usually be traced to too thick a letter, or thick objects in a letter, which will cause the friction coupling of the roller drive mechanism to slip. Should this occur, the keyboard should be disengaged immediately and the condition corrected.

A letter counter is included in the letter insertion assembly to indicate the number of letters sorted per keyboard. A set of trip fingers, 1528, are mounted between the rollers and are actuated only when a letter is present. The movement of these fingers is transferred to an electric counter through shaft 1525, toggle lever 1529/1249, spring 1533, lever 1532, and lever 9423, closing the contacts of switch 507 (drw. 1027.25.000). The counter is actuated by the movement of the bottom flap of the letter slot by catch pin, 1518, mounted on rod 1517, at the time the bottom flap is closing again.

The keyboard switch button, 1413, is located on the front of the insertion assembly. The action of this button is transferred to the switch through a spring and lever mechanism 5126, and 5028 on drw. 1027.23.000. This spring loaded coupling absorbs shock and prevents damage or deformation of the switch mechanism.

3. MARKING KEY ASSEMBLY (Drawing No. 1027.23.000)

The marking assembly marks each letter with a distinctive character just before the letter is ejected into the carrier trays, and it consists of a marking character, 1608, attached to a character holder 1605. During marking, the letter is supported from behind by an impression buffer, 1579 which is faced with a hard leather surface, 1580.

The character holder must be inserted in the keyboard before the keyboard will operate. It unlocks the keyboard by disengaging the hooked end of lever 1601 from shaft 1085 which, in turn, actuates the keyboard through lever 5022. When disengaged from lever 1601, shaft 1085 moves up and down through the action of a camshaft transmitted through rod 1567, lever 1568, shaft 1565, and arms 1534.

When the character holder is removed from the keyboard, the keyboard action is blocked through levers 1603, 1601, and spring 1604. The spring loaded impression buffer 1579 and the marking character 1608 are both actuated by shaft 1576. Shaft 1576 is rotated back and forth by a cam by arm 1573 and rod 1575. As the marking buffer is moved forward, the character is also moved by the action of arm 1583, 1585, and toggle lever 1586, shaft 1591, and arm 1593. The marking character is driven forward by lever 1593 and spring 1590, which is under tension, and released by toggle lever 1586.

A marking character is inked by a typewriter ribbon which passes over the face of the character, and over two pins 1597, and onto two spools. The winding mechanism is automatic, and only the winding spool is driven while the other runs free.

The winding mechanism is driven by rod 5042 which actuates lever 1213. This lever pivots on pin 116 and is connected to double pawl 1215 by means of pin 1216. A hairpin type spring, 1217, between the pawl and lever, keeps the end of the pawl either against the right-hand or left-hand spool depending on which is being driven at the time. The movement of lever 1213 moves the pawl and turns the spool holder one tooth at a time. A counter-pawl, 1218, and spring 1221, prevent the driven spool from unwinding.

Two levers, 1227 and 1228, are provided which automatically reverse the winding action of the mechanism when one of the spools is completely unwound. When this occurs, the double lever falls into a slot in the empty spool holder and the tip of the lever lies in the path of the driving pawl 1215. The driving pawl strikes the tip of the lever and is reversed so that it begins driving the other spool. The counter-pawl 1218 is reversed by eccentric pins 1220 on this pawl.

In the event the winding mechanism does not reverse properly, the tension of spring 1217 should be checked. The driving action of the pawl can be adjusted by changing the position of pivot 5040 of lever 5041 which is fixed in a slotted hole. As the ribbon winds and unwinds it is constantly inked by an inking device which consists of an ink reservoir, 4969, with lid 4970 and a felt ink roller 4971. The reservoir should be kept filled with a good quality stamp ink.

4. THE LETTER FEED CONVEYOR (Drawing 1027.24.000)

Five letter feed conveyors are provided on the Transorma to transport mail to each of the operator positions. In each conveyor, there are four chains running in the bottom of the conveyor trough which are driven by four sprockets, 1145, fixed on a common shaft, 1142. The drive mechanism for this shaft consists of a toothed wheel, 5066, affixed to the shaft between two freely-rotating discs, 1147. A ratchet 5067 is attached to these two discs at their perimeter and engages the toothed wheel, 5066, which is between them. Attached to the two discs, on the opposite side, is a push rod 5068 at the lower end of which is a ball bearing cam follower 503. This push rod is actuated by a cam shaft and imports a rocker-arm motion to the two discs and the ratchet which is attached between them. When the push rod is raised by the cam shaft, the ratchet engages the toothed wheel, 5066, and drives the conveyor chains. When the push rod moves down, the ratchet slides over the toothed wheel which is held from turning by a counter pawl, 1150, on pin 1151 which is fixed in a slotted hole for adjustment.

This feed action is controlled by the position of the leading letter in the stack in the conveyor. The manner in which this action is automatically controlled is shown in drawing 1027.25.000.

At the extreme forward end of the conveyor are two feeler fingers 5089 which are used to hold the leading letter in the stack in position. These fingers contact the front letter in the stack as it arrives at the proper position and release it at the proper time for feeding. The fingers, 5089, are mounted on a common shaft 5086 to which lever 5090 is also attached. This lever connects to a catch pin, 5078, through a locking bolt, 5074, and an adjustable link, 5075. This linkage is coupled to cam 5312 and lever 5313 (See drawing 1027.25.000) which moves the fingers back out of the way as the leading letter is removed from the front of the stack.

At the loading end of the conveyor is a sprocket roller, 5083, over which the conveyor chains are led. One of the sprockets on this roller actuates the driving chain which moves the letter push plate, 5092. This moves the push plate forward at the same speed as the transport chains in the bottom of the conveyor. The tension of the chains is adjusted by sliding roller 5083 backward or forward in the mounting slots provided. The tension of the chain which drives the push plate is adjusted by tenions roller 505 and bolt 1165.

The support plate engages its drive chain by means of a pawl, 5094, mounted behind the plate. It is also supported by a sliding holder attached to rails 1637/1638 and rides on three ball bearings. The back plate may be repositioned from the loading end of the conveyor by means of lever 1661 which is attached to rod 1652. This disengages the support plate from the driving chain and permits repositioning the plate to the loading end of the conveyor. Therefore rods 1658/1659/1660 are arranged so that they are folded when doing so.

The letter feed conveyor may be actuated manually by turning hand wheel 1144 at the forward end of the conveyor.

5. AUTOMATIC FEED (Drawing 1027.25.000)

As the leading letter of the stack in the feed conveyor reaches the extreme forward end, it is automatically removed by a vacuum feed cup mounted on a reciprocating feed arm.

The position of the leading letter in the stack is accurately controlled by fingers 5089 (See drawing 1027.24.000) and a feeler lever, 5338, which is mounted near the vacuum feed arm 5210 and moves along with it, contacting the letter stack with each stroke of the feeler. The motion of this feeler is obtained from cam 5232 through lever 5235, and spring-loaded rod 5335-5336, and spring 2159. This spring linkage prevents damage to the mechanism when the feeler lever comes in contact with something preventing the feeler to move freely. When this occurs, the movement of lever 5235 is taken up by the groove in rod 5335.

Attached to feeler lever 5338 is a stop-pin, 5399, which actuates an electric switch, 507. Switch 507 is actuated only when lever 5338 can make a complete stroke. This will occur either when the leading letter has just been removed by the feed arm, or when the stack of letters in the feed conveyor has not yet reached the forward position. Switch 507 is normally open and is closed only momentarily by the action of the feeler arm.

Switch 507 is connected to a relay-solenoid, 508, located on the side panel of the machine. This relay is provided with a take-over contact which holds the relay closed when the feeler lever is no longer in contact with the switch arm. The armature of the relay connects to a bolt, 5332, which blocks the movement of the conveyor push-rod, 5068, by engaging pin 5079 (Drw. 1027.24.000). When the relay is energized, this bolt is withdrawn and the push rod follows cam 5311 to move the letter stack forward in the feed conveyor.

The relay is de-energized by lever 5041 (Drw. 1027.23.000) which actuates switch 528 to break the circuit. When this occurs, the movement of push rod 5068 is again interrupted by the bolt 5332 connected to the relay armature.

This action is repeated with each movement of feeler lever 5338 until the leading letter of the stack has been moved forward into proper position, at which time, the letter interrupts the motion of feeler lever 5338 so that contact 507 is not actuated. When this occurs, bolt 5332 prevents further movement of the conveyor feed mechanism.

The feed rate of the conveyor can be adjusted for different letter thicknesses by a dial indicator and knob 5246/5249/5250. This dial moves the position of switch 507 either forward or backward through a cam and rod linkage, and in turn, lengthens or shortens the stroke of arm 5338 which will be required to close the switch and thereby actuate the feed mechanism.

The vacuum feed cup, 9435, mounted on the vacuum feed arm 5210 as the feeler lever, is actuated by a vacuum pump, and with each movement of the arm it removes the leading letter from the stack. As each letter is removed, the letter-holding fingers at the front of the conveyor are moved forward through the action of lever 5315 and cam 5312. Letters are released by the vacuum cup when the feed arm reaches its highest position at plate 5297. At this moment bleeder valve 5191 opens the vacuum pipe 5192 to relieve the vacuum in vacuum arm 5210 and the letter drops into the slots in view of the operator, and rests on support 5280. At this point the operator can read the destination of the letter and press the appropriate keys when the letter reaches the inverter 5173.

The letter is moved to the inverter, 5173, by a push-pin which is attached to an endless chain, 502. As the letter reaches the inverter, it is held in position by plunger 5178 which moves forward and presses the letter against the front of the inverter. The inverter tilts the letters 90° to the vertical position through the action of cam 5145, roller 5163, and spring loaded levers 5162, 5166, 5167, 5175, and 5176. When this action is complete, plunger 5178 retracts and the letter drops into the insertion assembly (Drw. 1027.22.000).

Two safety devices are provided in the automatic feed assembly to prevent damage to letters. The endless chain which pushes letters into the inverter is coupled to the main drive shaft through a spring overload clutch. This clutch disengages in the event more than normal force is required to drive the chain. The clutch couples gear 5153 to shaft 5151 which is driven from the main shaft, 5141, through a set of bevel gears, 584. The clutch consists of a pawl, 5156, which is held in engagement with gear 5153 through pressure of spring 5160. When the driving force through the gear exceeds the tension of the spring, the pin disengages and the drive shaft rotates normally while the gear drive stops. When the overload is removed, the spring-loaded pin automatically re-engages the gear at the proper point so that the chain again operates in synchronization with the rest of the feed mechanism. As an additional safety precaution, push-pin 5275 is attached to the endless chain through a pivot and is kept in position by a spring.

When more than normal force is required to move the letter, the pin folds back against the pressure of the spring and slides past the letter, preventing damage.

The electric letter counter, 589 (see "Insertion Assembly") is mounted on panel 5131 in full view of the operator. This counter automatically registers the total letters sorted at the operator position.

6. KEYBOARD (Drawing 1034.26.000)

The indexing fingers on the letter carriers in the carrier train are positioned by the action of the sorting keys on the keyboard. The keys consist of key buttons 1008/1009 affixed to key shafts 9410, 9411 or 9417. A snap-action toggle lever 1032 is located under each key shaft, and when the key is depressed, the lever is actuated and closes a single, double, or triple contact switch located directly underneath it. Switches are mounted on the base plate, 9381 and are wired together as shown in the schematic diagram. Wiring terminates in socket 506 which carries 10 contacts, 9 for actuating the tumbler positioning solenoids, and one for the supply voltage. The socket is mounted on bracket 9387 on the frame of the keyboard, 9388.

The keyboard can be removed for inspection purposes by loosening bolts 5415. Before removing the keyboard, the cable to socket 506 should be disconnected.

A complete cycle of operation of the keyboard is as follows: when a key is depressed, the toggle lever under it is moved through the dead-center position and snaps down under the tension of spring 1048. As the toggle lever moves down, it closes the electric switch under it, which in turn actuates the solenoids 5113-5114 in the carrier train indexing assembly after closing contact 5368 (Drw. 1027.25.000). The solenoid circuit is held closed until contact 5368, actuated by a cam, breaks the circuit. Then the repositioning bar, 9392, which is driven by a cam, moves up and returns the toggle lever to its original position. The driving linkage for the repositioning bar, 9392, consists of levers 9397, push rod 9399, and adjusting screw 5406, driven by a cam in the insertion assembly (Drw. 1027.22.000).

The timing of this sequence, as well as the time allowed for the operator to press the sorting keys, is given on the cam diagram, (Drw. 903.374.641).

A cancel key, 4964, is located just below the sorting keys on the keyboard. This correction key opens the main power circuit to the keyboard and prevents the solenoids and the indexing assembly from being actuated. When the correction key is used, the letter being sorted is diverted to the "zero" receptacle. The correction key actuates a switch under it through a toggle lever similiar to those used for the sorting keys. The repositioning bar also returns the correction key mechanism to its "off" position at the same time it resets the rest of the keys on the keyboard.

A complete electrical wiring diagram on the Transorma is shown on drawings 1034.71.000-A, 1034.71.000-B, 1034.71.000-C and 1034.27.000-A.

7. LETTER VACUUM SYSTEM

To provide the necessary vacuum for the letter feed mechanism, five vacuum pumps with air filters are provided on the Transorma.

A vacuum line from each pump leads to a cam-operated bleeder valve 5191 in its respective keyboard, and from the valve to the vacuum cup on the feed arm 9435 (Drw. 1027.25.000). The motion of the feed arm and the opening and closing valve are synchronized so that the vacuum is turned on and off at the proper time.

An air blower is also provided on the Transorma to supply low-pressure air for separating letters at the letter feed. An adjustable nozzle is mounted above each of the letter conveyors which directs an air stream down on the first few letters in the letter stack. The air stream may be turned on or off by means of a control located near the first keyboard. This air stream aids in keeping unsealed letters from opening up its flap (parachuting) when falling down into the slot.

C. LETTER TRAY TILTING ASSEMBLY (Drawing 1034.31.000)

The purpose of the letter tray tilting assembly is to tilt the letter trays in the letter carrier train to the proper angle and to lock them in this position. To accomplish this, 10 separate assemblies are arranged, one after another, above the letter carrier track, each corresponding to one of the ten possible letter tray positions. All tilting assemblies are identical except for the last which is a locking device only.

For tilting the trays, the section of the carrier track beneath the assemblies is fitted with a curved guide rail 9728 which engages the roller arm 1242 (drw. 1004.11.000) attached to the bottom of each letter tray. As the trays move over this section, the camming action of this curved guide rail first tilts all trays to the extreme right-hand position and then back again through each position successively as the carrier passes under successive tilting mechanisms. When the proper tilt angle is reached, as determined by the carrier finger indexing, the tray is locked in this position by the tilting assembly that corresponds to this position.

Trays are locked by a locking arm, 1321, which projects down from the tilting assembly and has a roller, 501, at its lower end. The locking arm is held in position by pawl (drw. 1011.31.801) which is actuated by feelers 1317 which line up with the indexing fingers on the letter carriers. The feelers are kept in a vertical position by spring 1318. When a particular letter carrier is to be locked by one of the tilting assemblies, the indexing fingers in the carrier will be depressed so that they do not engage the tilting assembly feelers as the carrier passes beneath. The locking arm of the assembly 1321 remains in a vertical position and engages the locking lever of the carrier as it passes and locks the carrier in the tilt position which corresponds to this particular assembly. Carriers which are not to be locked at this assembly are not indexed so their fingers trip the feelers. This in turn, trips the pawl which holds the locking arm in its vertical position so that it does not engage the locking lever of the carrier.

The tilting assembly is re-cycled between each carrier by a cam-faced lever, (drw. 1011.31.805) which is actuated by the ball bearing wheel 506 (drw. 1004.11.000) on the face of the inside wheel of the carrier. (This is the same wheel which also actuates the keyboard assembly from the carrier).

Cam lever (drw. 1011.31.805) repositions the locking arm, 1321, into the vertical position through levers, and shaft (drw. 1011.31.803). Spring 1325 keeps this linkage under tension and moves the blocking arm out of the locking position when pawl (drw. 1011.31.801) is lifted by feelers.

From the sequence of operation of the tilting assembly, it can be seen that letter trays are locked in position only when feelers 1317 are not engaged by the indexing fingers of the carrier. When a locking assembly does not go through its sequence of operation, the carrier is locked. The last of the locking stations consists of a fixed roller, 1330/502. No trip fingers are used at this station inasmuch as it corresponds to the "zero" indexing position. This station locks all carriers for zero sorting for which no key need be depressed on the keyboard. A diagram of the positioning of the feelers at each locking station is shown in accompanying drawing 9341.

The height of the locking arm, 1321, may be adjusted by raising or lowering its shaft in the mounting slots. The height of lever (drw. 1011.31.805) may be adjusted in the same manner, as necessary. When this adjustment is made, rod 1322 should be readjusted accordingly. The length of the feelers is adjusted by inserting or removing washers at their upper ends.

The tension of spring 1318 which resets pawl (drw. 1011.31.805) and also holds the feelers in a vertical position should be periodically checked. If there is insufficient tension on this spring, resetting of the tilting assembly will be too slow and faulty locking of trays will result. When spring 1318 is installed or replaced, it should be wound through an angle of 180° to 240° before being engaged.

All pivot points of the tilting assembly should be periodically lubricated with light oil, except the cam surface of lever (drw. 1011.31.805) which should be lubricated with heavy oil.

D. CARRIER EJECTING STATIONS (Drawing 1034.31.000)

The carrier ejecting stations control the ejection of letters from the letter carrier trays. The operation, as well as the parts used in the ejecting stations, is similar to the tilting assembly. A carrier ejecting station is located above each row of receptacles, and each assembly operates precisely in the same manner as the tray tilting assembly except that arm 1321, which projects down from the assembly, engages the trigger which unlocks the tray bottom and ejects the letter.

The position of the indexing fingers on each carrier determines which station will eject letters. As was the case with the tilting assembly, the action of the ejecting assembly is negative; the ejecting assembly will always eject the letter from a carrier tray, unless the feelers are engaged by the indexing fingers of the carrier. The last ejecting assembly consists only of a fixed roller, 502, which depresses the ejecting trigger on all carriers which are "zero" indexed. No feeler fingers are required for this station since no indexing is required for a "zero" sorting. Lubrication and adjustment of the carrier ejecting assemblies is the same as that for the tilting assemblies.

A complete diagram of the ejecting finger indexing code is given on drawing 9341 (Drawings 9340-3559 are testing diagrams).

E. CARRIER REPOSITIONING ASSEMBLY (Drawing 1034.31.000)

As the empty letter carriers leave the receptacles, the repositioning assembly returns them to the neutral position and, in addition, resets the indexing fingers to neutral position.

A series of ten guide rails, 1740/1749, are arranged under the carrier track to engage the tilting roller of each carrier regardless of what position it may be in. The guide rails displace each carrier tray to the right just enough to relieve the pressure of the tray tilting spring on the quadrant pawl. The pawl is then disengaged from the quadrant by the action of cam 3308 and locked out by the pawl trigger. (See paragarph "A" under "LETTER CARRIER TRAIN"). At this point, the guide rail prevents the tray from swinging to its extreme left or neutral position, under the tension of its spring.

At the end of each guide rail is a leaf spring, 1750/51, mounted so that it forms an extension of the guide rail. When the rollers on the bottom of the carrier trays pass over these springs, they bend to form a guide which brings the tray to the neutral position smoothly. In the event one of these springs is broken, it should be replaced immediately to avoid excessive vibration and damage to the letter carriers.

After being reset to the neutral position, the trays are repositioned to the vertical by curved guide plate 9729 which engages the lower roller of each tray. Trays are kept in vertical position as they pass under the keyboard by straight guide rails on each side.

Just before reaching the keyboard positions, the bottom of each tray is closed by cam 3314. The roller at the top of the tray-closing mechanism on the carrier contacts this cam, and as the carrier travels along, the roller is depressed, closing the bottom of the tray. Cam 3314 may be adjusted up or down by means of the mounting slots. This adjustment may become necessary as the tires of the carrier wheels become worn.

The last unit in the repositioning assembly is roller 1793 which repositions the indexing fingers of the letter carriers. This roller is mounted on an eccentric shaft, 1794, and its position may be adjusted by turning the shaft. This adjustment is used for establishing the height difference between indexed and unindexed fingers. The higher this roller is set the greater will be the distance between indexed and unindexed fingers. This adjustment is unaffected by carrier tire wear. After passing this repositioning roller, the carrier has completed its cycle and is ready to begin a new operating cycle.

The bearing surfaces of all guide rails, cams, etc., of the repositioning assemblies should be periodically lubricated with heavy oil.

F. THE DRIVE (Drawing 1012.52.000)

The Transorma is driven by an electric motor which is coupled directly to a worm reduction gear, and to a vertical drive shaft through a flexible coupling, 514. The vertical drive shaft, 3428, drives the driving drum of the machine through an over-riding coupling, 1811/1815. The driving drum has 6 sprocket teeth which mesh with the heads of the connecting pins between the carriers in the carrier train. This driving drum also functions as a brake drum and is fitted with a brake band, actuated by a weight, 3046. The brake is set or released by an electromagnet 517.

When the main switch of the machine is in the "off" position, current to the motor as well as the brake magnet is turned off and the brake is automatically set by weight 3046. When the machine is in operation, the magnet lifts the weight and the brake is released.

Braking action may be adjusted by shifting the position of brake weight 3046. Brakes are correctly adjusted when the machine comes to a stop in approximately 3 carrier lengths. Too short a braking distance may cause damage to the carrier train, and too long a distance will make it impossible to stop the machine quickly enough in the event of malfunctions.

The carrier train may also be moved by hand, when necessary. Before doing this, the brake should first be released by raising the brake weight, by pressing the main switch button.

CAUTION:

Never move the carrier train in the reverse direction. The feelers, cams, levers and other mechanism associated with the movement of the carrier train are designed to operate in one direction only, and will be damaged if the carrier train is moved in the reverse direction.

The oil level in the worm gear box should be periodically checked and the supply replenished if necessary. An oil gage is provided for this purpose. Heavy grease should be used as required in grease fittings of the drive shaft bearings and couplings

G. SAFETY DEVICES (Drawing 1034.31.000)

In addition to the keyboard safety device (See paragraph B), there are four other safety switches located along the track of the carrier train. Each of these devices has been installed to insure safe, reliable operation of the machine. Each stops the machine and lights a signal lamp when a malfunction occurs. In the normal operating position, the contacts of all safety devices are closed.

The first safety device is located on the carrier track just after the tray tilting assembly (Section"AA" darwing 1034.31.000). In the event one of the carrier trays is not properly locked in a correct tilt position, the bottom roller of the tray touches one of the pins, 1924, in the curved cam strip, (drw. 1011.31.816). The cam strip is moved to one side and the safety switch is opened. Before resetting the safety switch and starting the machine, the cause of the malfunction must be definitely determined. Improper operation of the tray locking mechanism, inadequate lubrication, bent or broken parts in the tray mechanism, are possible causes for the tripping of this safety device.

A similar device is located just after the letter discharge chutes. This device is actuated in the event letter chutes are blocked and letters protrude from the chutes or the tray bottoms. Faulty tilting of the tray may also trip this safety device.

At the point where all trays are returned to the neutral position, another safety device is provided to insure that all trays are in the neutral position and their bottoms are open. This device will be tripped in the event there is a too thick letter in the tray or when the tray mechanism is not operating properly. (Section G.G. on drw.)

The last safety device on the carrier track is located under the fifth operator station. This device is tripped if the tray bottoms have not closed properly. This device will also be tripped if the tray bottom flaps have reversed their closing action, and are swung out rather than in. (Section F.F. on drw.)

As a general precaution, when any of the safety devices has tripped, the machine should be inspected to make certain that no damage has occured and that no letters are blocking the mechanism. One of the safety devices may occasionally be tripped due to vibration, but this should not be assumed unless no other cause can be found. The signal lights for these safety devices are located near the first keyboard. The lights for the safety devices in each individual keyboard are located in front of each operator position.

A motor starting light is also provided at the first operator position, and whenever this lamp is lighted the machine is ready for operation. (See wiring diagram 903.374.60). This signal lights as soon as the start button is pressed and continues to light as long as the machine is operating normally. The light is extinguished as soon as any of the safety devices is tripped. Unless the signal is lighted, the speed control should not be turned from its zero position to start the carrier train moving. All electrical circuits of the Transorma are controlled by the main starting switch. When it is turned off, the vacuum pumps, air pump, stacking motors, etc., will also be turned off, and their individual switches, where provided, will be inoperative.

H. THE SORTING RECEPTACLES (Drawing 1011.41.000)

To avoid defacing mail, receptacles should always be kept clean. The chutes 1704 and 1705 should occasionally be rubbed with talcum powder, especially during damp weather, to insure smooth operation and neat stacking of letters in the receptacles.

The chute indicator lights, 535, should always be turned on when the machine is in operation, and the lenses, 530, should be kept clean. When lights are changed, make certain that the lenses are correctly positioned to insure highest brilliance.

In the event one of the discharge chutes to the receptacles becomes blocked, the following procedure is recommended:

1. Stop the machine.
2. Remove as many letters as possible, by hand, from the top and bottom of the chute.
3. Using a smooth wood slat, push all remaining letters down from the top of the chute and out through the receptacle.
4. After the chute has been cleared, inspect the chute with a light and mirror, if necessary, to insure that it is entirely free and undamaged.

1. SPECIAL RECEPTACLES (Drawing 1034.42.000)

The drawer-type stackers, which have a larger mail capacity, are equipped with star wheels, 5450, to aid in stacking sorted letters. When empty, the drawers are in their closed position and as mail is stacked in the drawer, it slowly moves out. The drawers slide on ball bushings, 503-504-510, mounted on two bars, 5436. The star wheels are driven by shaft 5446, and this shaft is belt-driven from an electric motor, which is turned on by the main switch of the machine.

Letters are guided to the star wheel by guides 5457 and 5458 which position the letters vertically in the drawer tray. As succeeding letters are received, they are stacked one behind the other and the drawer slowly moves forward as the stack builds up.

When the drawer is filled, an electric contact 513/5456 actuates a buzzer signal.

A safety contact 513/5471 is provided at the outlet of the letter chute to the drawer. This is tripped in the event letters do not stack properly. This safety contact activates a buzzer signal as well as an indicator light.

I. ELECTRIC POWER SYSTEM

The power system of the Transorma is designed for 3-phase alternating current operation. The light system of the machine will be operated on a single-phase source. A complete wiring diagram (except for keyboards) of the machine is shown on drawings 1034.71.000-A, 1034.71.000-B and 1034.71.000-C. Drawing 1034.27.000-A shows the 24-Volt D.C. wiring of the keyboards. Complete diagrams for the erection of wiring conduits are shown in drawing 1034.72.000-A.

1. POWER CIRCUIT

The main drive motor is a 3-phase commutator motor rated at 1-1/2 hp., 1800 rpm (220 volt-60 cycles). A magnetic-type starting switch is used for starting the main motor, and it is interconnected with the auxiliary switches and safety devices. Motor speed is controlled by means of a variable resistance to provide a speed adjustment from half to full-rated motor speed. This resistance is controlled by the speed hand wheel and is provided with an "off" position.

Before starting the machine, the hand wheel should always be in the "zero" position, and before the machine is turned off with the main switch, the speed hand wheel should first be turned to "zero".

Starting procedure is as follows:

1. Make sure the speed wheel is in the "zero" position.
2. Press the main switch button to turn on the auxiliary motors, lights, brake etc.
3. Check to be sure that all safety lights are out and that the operating light is on.
4. Slowly turn the hand wheel until the desired operating speed is reached.

(The main motor drive will not start until the hand wheel is moved off the "zero" position.)

When the main switch is pushed, the low voltage DC for the keyboards is also turned on but each keyboard must be turned on individually by its push button and marking key.

In bringing the machine up to operating speed with the hand wheel, do not turn the wheel quickly. The machine is provided with an overload circuit breaker and accelerating the machine to operating speed too quickly may trip the overload switch. Whenever the machine is stopped by one of the safety devices, the speed hand wheel should be turned to the zero position and the machine should be inspected. Then the tripped safety device can be reset in the working position. After the main switch button has been pressed, the auxiliary circuits are in operation and at the same time the brake is released so that the carrier train may be moved by hand if necessary for correcting trouble. When the machine is again ready to operate, as indicated by the operating light, the hand wheel may again be turned to start the main motor.

An overload cutout is provided in the low voltage DC supply to each of the five keyboards to prevent mis-sorting in the event the keyboard circuits are not operating properly. These cutouts are connected to a common signal light at the first operator position. (The keyboard causing the overload can be determined by inspecting the cutouts which are all located at one central point).

2. LIGHTING CIRCUITS

A separate distribution box is provided for the lighting circuits, with appropriate fuses and terminals for the platform, keyboard, and ceiling lights, and the low voltage receptacle indicator lights and AC signal lamps. (See wiring diagram 1034.71.000-B.)

There are two low-voltage AC circuits; a 12-volt circuit for the indicator lamps for the receptacle chutes, and a 24-volt circuit for the lights and buzzers which indicated filled receptacles. A relay is wired into the 24 volt circuit to actuate the general signal lamp when any of the receptacles is full.

PART III

INSTRUCTIONS FOR MAINTENANCE AND INSPECTION OF THE TRANSORMA LETTER SORTING MACHINE

A. SORTING ERRORS AND THEIR CAUSES

Sorting errors can be divided into two groups; operating errors and those due to machine malfunctions.

1. OPERATOR ERRORS

Improper operation of the keys: If keys are not fully depressed, carriers will not be properly indexed and sorting errors will occur. The same type of error will occur if more than one key is pressed within each of the digit groups. Number selections should be made at the keyboard in a definite, positive manner to avoid this type of error.

Memory errors. Rarely-used address codes may also cause sorting errors. When the operator is not sure about the correct code number, it is usually better not to attempt to sort the letter. The letter will then arrive at the zero receptacle, confining all memory errors to this single receptacle.

Illegible addresses. Letters which are difficult to read should simply be sorted to the zero receptacle.

2. MACHINE ERRORS

In general, errors made by the machine can be distinguished from errors made by the operator by the regularity of their occurrence. This is best illustrated by several examples. When there is a malfunction at one of the ejecting stations, all letters in a certain vertical row of receptacles on both sides of the machine will show consistent mis-sorting.

If one of the carriers or one of the keyboards is not operating properly, all mis-sorted letters will bear the same marking key identification, provided no operators have changed seats.

As another example, if all letters intended for receptacles 100 to 104 and 300 to 304 are actually delivered to receptacles 105 to 109 and 305 to 309, this indicates that the feelers of the ejecting gear are not in the proper position e.g. one is missing. The combination of feelers over the first group of receptacles has become the same as the combination over the second group. In this case, again, there is a regularity to the error which indicates improper operation of the machine rather than operator errors.

Still another indication of this type of error shows when letters intended for the bottom row of receptacles are delivered to other rows. This immediately indicates a malfunction in the inclining or tilting mechanism. As is apparent from these examples, defects in the ejecting mechanism will cause consistant errors in the vertical rows of the receptacles, while defects in the tilting mechanism will produce errors in horizontal rows on both sides of the machine.

Serious discrepancies of this kind should be repaired immediately. However, minor mis-sorts are best repaired during a change in shift of operators or at other times when the machine is not actually in use.

Minor or occasional sorting errors are most easily traced by clearing the machine and setting the number code for the mis-sorted letter on one of the keyboards. Weights are provided to keep the keys depressed while the machine is operated by hand to observe the cause of the error. The same sorting number should not be depressed on all five keyboards at the same time, otherwise all carriers will be tilted and emptied in the same manner and it will be difficult to trace the error to any particular keyboard. In addition, by testing each keyboard in succession, it is possible to observe and distinguish between errors in the ejecting gear, the tilting gear, or the finger indexing mechanism.

When the difficulty appears to be with the opening and closing of a letter tray in a particular carrier, the carrier should be moved slowly by hand through the tilting assembly and discharging assemblies to be sure that all the pawls are properly struck and all fingers and feelers operate correctly.

B. MAINTENANCE

The following maintenance instructions apply to a five-keyboard Transorma Letter Sorting Machine using 250 to 300 receptacles and operating a mimimum of 48 hours per week:

1. LETTER CARRIERS

Each day, three carriers should be cleaned, inspected and lubricated. Inspection should include:

1. Tire wear. (Replace when worn down to 3 inch diameter.)
2. Spring tension on the indexing fingers. (Tension should be at least 1 lb.)
3. Tray opening and closing mechanism.
4. Slot clearance between ejecting springs which should be approximately 1/4 inch when tray bottom is closed. These should just touch one another when the bottom opens.

The adjustment of the quadrant pawls should be checked every four months.

2. KEYBOARDS

The entire keyboard assembly with the exception of the keys should be cleaned of dust and inspected and lubricated once a month.

Once every two months the operation of the indexing tumblers should be inspected. The tumbler cam assembly should be removed, if necessary, to accomplish this inspection which should include:

a. The overlap of the locking pawl, 5109, which should be .030 inch to .039 inch. If adjustment is necessary, this can be made with set screw 528. One revolution of this set screw provides a vertical displacement of the tip of the pawl of .068 inch. The adjustment is made by turning the screw until the pawl just releases the tumbler wheel cam, and then turning the screw back one-half turn. This will provide an overlap of .034 inch. A wrench is provided for tightening the lock nut after this adjustment has been made. Care should be taken to prevent the screw from turning when the lock nut is tightened.

b. After the tumbler cam assembly has been reassembled, the clearance between the locking pawl and the tumbler cam should be checked. This clearance should be approximately .039 inch when the positioning bar 5104 is in its highest position. This neutral position is obtained by rotating cam 4424. The clearance between the locking pawl and tumbler cam is adjusted by bolt 1422. After the adjustment is made, the locking nut should be tightened. If the clearance between all tumbler cams and all locking pawls is not uniform, but is greater at one end than at the other, an adjustment can be made at the shaft 1428 which supports the tumbler cams. This shaft can be moved horizontally in its slotted mounting in wall 5107. A mirror placed under the assembly may be helpful in performing this inspection and making the necessary adjustments.

The electrical operation of the keyboard assembly is tested with the special test lamp box which is supplied. The cable to the keyboard should be removed from the socket and the cable from the lamp box connected in its place. When various number combinations are made on the keyboard, corresponding lights will light in the test box. A diagram is included on the lamp box so that the operation of the circuits can be easily and quickly checked.

Inspection of keyboards should also include:

a. Opening and closing of the letter insertion assembly.

b. Inspection of the rubber face on the insertion roller.

c. Operation of the slip coupling which drives the insertion rollers.

d. Operation of the counter rollers and supporting brackets.

e. Operation of the letter counter.

f. Position and operation of the letter counter fingers.

g. Position and operation of the marking impression buffer.

h. Operation of the feed conveyor drive.

i. The inking and ribbon transport mechanism.

j. The letter feed arm, vacuum system and feeler levers.

k. Chain tension in the feed conveyor.

l. Operation of the keyboard safety switch and signal lamp.

Once a month, the contacts of the keyboard switches should be checked. Care should be taken to avoid deforming the spring leaves of these switches. Any necessary adjustment should be made according to the diagrams, and operation should be checked by using the test lamp box.

3. LETTER TRAY TILTING AND EJECTING ASSEMBLIES

Once a month, these assemblies should be cleaned and lubricated. Special attention should be paid to the coil spring around the feeler shafts, and any formation of rust between the spring and the shaft should be removed and a light coating of oil applied.

Once every four months the following inspection should be performed:

a. Position of the locking ejecting arm.

b. Position and operation of the feelers.

c. Tension of the coil springs on the feeler shafts.

d. Height of the repositioning cams.

4. DRIVE

Every 9 months, the main drive worm gear should be drained and refilled with fresh oil, (Shell-Macoma 78 or equivalent). The motor ball bearings should also be greased at this time.

5. CONVEYOR TRACK

The carrier track as well as the interior of the machine should be periodically cleaned with a vacuum cleaner. Every 2 months, the running surfaces of the carrier track should be cleaned with the rail scrapers provided.

6. RECEPTACLES

Every 2 months the signal light lenses behind the receptacles should be cleaned, and if necessary adjusted for greatest brightness.

7. DISCHARGE CHUTES

Depending on humidity conditions, the letter discharge chutes should be periodically rubbed with talcum powder to insure smooth operation and correct stacking of letters in the receptacles.

To insure that all letter chutes are completely cleared at the end of each working period, a large envelope(approximately 6 inches x 9 inches)should be sorted to each of the receptacles. If this check is made using a different keyboard each time, a check of keyboard operation is also effected at the same time.

8. VACUUM PUMPS

Every three months the filters of the vacuum pumps should be cleaned. At the same time, the bearings should be lightly lubricated with grease (Esso Andok B, Shell Alvania 2 or equivalent), and brushes replaced if necessary.